IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Anil Seth et al.	Examiner: John Romano
Serial No.:	10/087,296	Group Art Unit: 2192
Filed:	March 1, 2002	Docket: 1488.008US1
Title:	A TECHNIQUE FOR COMPILING COMPUTER CODE TO REDUCE	
	ENERGY CONSUMPTION WHILE EXECUTING THE CODE	

REPLY BRIEF UNDER 37 CFR § 41.37

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
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Sir:

This Reply Brief is presented in response to the Examiner's Answer mailed on July 12, 2007.

REPLY

In response to the Applicant's pointing out that there is "no mention of code performance in Bartley, only efficient use of power,"[1] the Examiner answers that he relies on Li, not Bartley, for this limitation.

In reply, the Applicant points out as it did in its principal brief that Bartley and Li are directed to very different aspects of power reduction, and the reasons cited in the Examiner's Answer for combining them are not convincing. Additionally, the optimization goals of Li are in the context of changing sizes of cache and main memory,[2] not in the context of powering down different functional units as in Bartley, or selecting code locations to insert power down instructions while satisfying user-specified real-time constraints as recited in the Applicant's claims. Neither Bartley nor Li disclose the use of power down instructions in connection with the consideration of user-specified real-time performance constraints. Moreover, Bartley and Li are not properly combinable since they are directed to very different aspects of power reduction (*i.e.,* Bartley relates to turning off functional units via the insertion of power down instructions and Li relates to software and hardware modifications vis-à-vis memory design).

As stated on page 17 of the Examiner's Answer, the Applicant contends in its principal brief that Bartley and Li are not properly combinable since each is directed to very different aspects of power reduction. Specifically, Bartley inserts power-down instructions into programming to reduce power consumption, while Li relates to an embedded system where software and hardware components are designed and modified with power conservation in mind.

In his answer, the Examiner states that Li does not stand for the proposition that "a particular software transformation/optimization may not be considered,"[3] and the Examiner further states that in Li "it seems clear that software is transformed or modified/changed."[4] In reply, the Applicant points out that in its principal brief, it specifically noted that Li deals with

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1. Examiner's Answer, p. 16.
2. Li, § 4.3, ¶ 3
3. Examiner's Answer, p. 17.
4. *Id.,* p. 18.

the design and modification of software components with power conservation in mind.[5]

However, the fact that Li involves software modification has really nothing to do with the Applicant's contention that Bartley and Li are not properly combinable. That is, the Examiner fails to explain the relationship between the different aspects of power reduction that are disclosed in Bartley and Li with Li's disclosure of software modifications (in connection with determining memory and cache sizes).

The remaining points of the Examiner on pages 18 and 19 do not indicate that Bartley and Li are properly combinable. In the first full paragraph on page 18, the Examiner states that Li's disclosure of "software transformation/modification to optimize energy would be of interest to one of skill in the art . . . [so that] including software optimization comprising power down instructions as disclosed by Bartley would be inline with the modification/transformation of software to optimize energy." However, contrary to the Examiner's contentions, Bartley simply does not deal with software optimization. It deals with inserting extra software instructions into code to power down functional units. The addition of software code is an anathema to software optimization.

The Examiner then concludes in the last paragraph on page 18 that the combination of Li's teaching with Bartley's software transformation directed towards energy consumption is indeed proper. In reply, the Applicant simply and respectfully submits that Bartley relates to turning off functional units via the insertion of power down instructions, and Li relates to software and hardware modifications via-a-vis memory design (and does not relate to power down instructions). Consequently, Bartley and Li are not properly combinable.

On page 19 of the Examiner's Answer, the Examiner responds to the Applicant's statement that in Bartley "various power modeling techniques can be used to determine the length of time during which it is more efficient to turn a component off (or partially off) then on again versus leaving it on." In his response, the Examiner argues at length that Li discloses "user-specified real-time performance constraints" in Li's disclosure of a user specifying optimization goals.

The Applicant's discussion of various power modeling techniques was in response to the Examiner's contention in the Final Office Action that the motivation to combine Bartley and Li

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5. Applicant's Brief, p. 3, ¶ 3.

comes from Bartley. The Examiner contended that Bartley refers to program segments having a duration longer than a predetermined threshold, and then further contended that it is obvious that the threshold may be determined by a user selected algorithm or other input.[6] It was in response to this that the Applicant made its statement about the various power modeling techniques that could be used.

In his answer however, the Examiner now seems to change the subject and argue at length that Li discloses "user-specified real-time performance constraints" in Li's disclosure of a user specifying optimization goals. Although this seems to have little to do with the issue of the availability of power modeling techniques, the Applicant hereby replies by maintaining that Bartley and Li are not properly combinable. The Applicant has put forth several arguments in this Reply and its Principal Brief why this is so, and it is further illustrated in Li's disclosure that an embedded system performs one particular application that is known beforehand, for which the embedded system can be designed. The Applicant respectfully submits that any user-specified optimization goals during the design of an embedded system are not related to inserting power down instructions to turn off a functional unit during program execution as in Bartley, and hence the disclosure of any user specified optimization goals in Li would not have lead one of skill in the art at the time that the invention was made to combine Li with Bartley.

On page 22 of the Examiner's answer, the Examiner states that it is unclear to him what the Applicant means by the Applicant's statement that the presently claimed invention allows one to determine where among many places in the code that one can add a power down instruction to optimize power consumption within user-specified constraints. First, the Applicant respectfully submits that if this is unclear to the Examiner, then the Examiner's contention that Li discloses user-specified constraints, at the very least, seems suspect. Second, the Applicant respectfully submits that there is nothing unclear about this statement, especially in light of the disclosure of Bartley, since Bartley relates only to specific places in code to place power down instructions to turn off functional units that are not being used. The presently claimed invention on the other hand relates to a plurality of places in the code, not just places at which functional units are invoked, to place power down instructions based on user-specified constraints.

On page 23 of the Examiner's Answer, the Examiner attacks the Applicant's point that Li

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6. Final Office Action, p. 11.

relates to hardware design and Bartley relates to programming existing hardware. Specifically, the Examiner argues that the design constraints of Li involve software transformations for the purpose of energy optimization, and cites the second paragraph on page 5 of Li for support. However, this paragraph of Li further emphasizes the reason that Li and Bartley are not properly combinable. For the cited paragraph deals with software transformations in connection with constructing designs for certain memory sizes. Modifying software in connection with designing memory as disclosed in Li has little relation to inserting power down instructions to power down functional units as in Bartley, and hence one of skill in the art at the time that the invention was made would not have been lead to combine Bartley and Li. Therefore, the Examiner's statement that "Li suggests combing his teachings (of memory design) with any available software transformation to optimize energy such as Bartley's (i.e. addition of power down instructions to improve energy)" is simply not accurate.

On page 24 of the Examiner's Answer, the Examiner responds to the Applicant's arguments that the motivation to combine Bartley and Li as recited by the Examiner on page 11 of the Final Office action are not in accordance with law. Specifically, the Final Office Action stated that the motivation to combine Bartley and Li "is disclosed in Bartley, as he refers to program segments having a duration longer than a predetermined threshold."[7] The Applicant respectfully submits that Bartley's reference to code segments with a certain duration has no or little relation to Li's design of memory, and hence provides no motivation to combine Bartley and Li.

On page 27 of the Examiner's Answer, the Examiner takes aim at the Applicant's contention that Li does not disclose power down instructions. In response, the Examiner relies on Li's teaching of searching for design configurations with minimum energy dissipation while not exceeding the budget of clock cycles to execute.[8] The Applicant respectfully submits that designing a system to minimally dissipate energy and to not execute budgeted clock cycles does not disclose power down instructions. The Applicant further respectfully submits that neither Li nor Bartley disclose a "number of power down instructions that can be inserted in an execution path, including one or more identified potential locations" and a "number of additional cycles of

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7. *Id.*
8. Li, § 5.2, ¶ 4.

execution time the user is willing to incur due to insertion of power down instructions at each of the identified potential locations." Li mentions a budget of clock cycles to execute, but not a number of cycles of execution time a user is willing to incur due to the insertion of power down instructions.

On page 28 of the Examiner's Answer, the Examiner attacks the Applicant's contention that the number of user-specified power down instructions and the number of additional cycles of execution time that are recited in claims 11, 12, 22, 32, and 43 are not disclosed in either Bartley or Li. The Examiner latches onto the Applicant's statement that the additional cycles of execution time relate to the extra execution time of the processor caused by the addition of power down instructions, and the Examiner argues that this is not in the claims. The Applicant respectfully replies that it is inherently recited in the claims since the addition of power down instructions, or virtually any type of processor instruction for that matter, will cause the processor to execute more cycles. Even absent that however, Li simply does not disclose a number of power down instructions that can be inserted or a number of additional cycles of execution time that a user is willing to incur due to the insertion of such power down instructions.

On page 29 of the Examiner's Answer, the Examiner attacks the Applicant's contention that Bartley is not concerned with the real time performance of the executing code. The Applicant respectfully reiterates that Bartley is concerned only with the power consumed (or not consumed) by a functional unit. There is no disclosure in Bartley of examining the real time performance of the executing code. In contrast, claim 1, for example, recites that the power is reduced "during the execution of the code."

In summary, the many arguments put forth in the Examiner's Answer dance around the issue. Neither Bartley nor Li disclose the use of power down instructions in connection with the consideration of user-specified real-time performance constraints. Additionally, Bartley and Li are not properly combinable since they are directed to very different aspects of power reduction (*i.e.,* Bartley relates to turning off functional units via the insertion of power down instructions and Li relates to software and hardware modifications vis-à-vis memory design).

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Therefore, for all the foregoing reasons, plus the reasons set forth in the Applicant's principal

brief, the Applicant respectfully requests the reversal of the rejection of the claims.

Respectfully submitted,

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